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# Methodological report: measurement of education-specific mating squeeze

Yolien De Hauw, Francesca Piazza and Jan Van Bavel



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*Abstract*

A long-standing theory in family demography points out that marriage rates for both men and women are affected by the number of suitable marriage partners available in the local marriage market. In its most basic form, the marriage squeeze hypothesis holds that marriage prospects are lower if the number of unmarried persons of the desired age is low. We propose to update the concept of the marriage squeeze in ways that make it more relevant for partnership and family formation today. This entails at least two things. First, given the increasing importance of unmarried cohabitation and given the fact that a growing proportion of children are born outside marriage in Europe, the concept and idea of the "marriage squeeze" should be broadened to include the effects of age-specific sex ratio imbalances on the "mating market" rather than on the marriage market only. That is: we should incorporate unmarried cohabitation. Second, education should be added to the dimensions of age and sex to quantify the mating squeeze in a more meaningful way. The expansion of higher education among women implies that women who want to find a male partner with the same or a higher level of educational attainment would increasingly experience an education-specific mating squeeze. Therefore, this paper reviews ways of measuring the education-specific mating squeeze and presents time series of measurements based on alternative methods and two different sources: the European Labour Force Survey (LFS) and Eurostat official statistics on population by five years age groups and sex.

*Keywords:* partner choice; marriage market; cohabitation; union formation; sex ratio; educational attainment

*Affiliation:*
*University of Leuven, Belgium*

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# Contents

## 1. Introduction

A long-standing theory in family demography states that marriage rates for both men and women are affected by the number of suitable marriage partners available in the local marriage market. In its most basic form, *the marriage squeeze hypothesis* holds that marriage prospects are lower if the number of unmarried persons of the desired age is low, all else equal. Conversely, marriage rates are expected to be higher, all else equal, if the number of potential spouses is higher.

This paper extends and updates the marriage squeeze hypothesis, mainly by including unmarried cohabitation and by taking into account educational assortative mating, i.e., the tendency that like matches like in terms of educational attainment (Schwartz & Mare, 2005). We designate the updated hypothesis as the *education-specific mating squeeze hypothesis*: rates of union formation (including unmarried cohabitation as well as marriage) with a partner of the desired educational attainment are expected to be lower for those who suffer a mating squeeze, i.e., for those who have a limited number of potential partners with the desired level of education. This dimension is particularly relevant, given that thereversal of gender inequality in education, with women now being more highly educated than men, implies that in particular highly educated women are increasingly suffering an education-specific mating squeeze (Van Bavel, 2012).

The aim of the paper is to review methods to measure the mating squeeze, both generally and when taking into account educational assortative mating. We only consider opposite-sex matches and disregard homosexual union formation. The following section presents a brief history of the concept of the marriage squeeze (which is here extended to include unmarried cohabitation). Next, major approaches to measuring the mating squeeze are outlined. Finally, we apply some of the approaches to Labour Force Survey data in order to estimate recent trends in mating squeeze in a range of European countries and discuss the practical implications and conceptual issues that arise when using different sex ratio measures.

## 2. Concepts of marriage squeeze: A brief history

The concept of marriage squeeze has been adopted to refer to the effect of an imbalance in the number of men and women on the timing and likelihood of marriage. Already in a paper published in 1953, John Hajnal commented that ages at marriage and the proportions marrying may be affected by the sex ratio at marriageable ages. The period of writing, just

after the Second World War, was characterized by high marriage rates, increasing fertility rates and economic growth.

After the so called 'Golden Age of Marriage' of the 1950s, marriage rates dropped and age at marriage increased. In this timeframe the term marriage squeeze was introduced by Glick, Heer and Beresford (1963) to refer to the effect of an imbalance between the number of males and females on marriage. They observed that the sharp rise in birth rates during the postwar baby boom combined with the almost universal custom that women marry men who are on average two or three years older, resulted in an imbalance between the number of potential brides and the number of potential grooms, twenty years later. This shortage of suitably aged men placed women in a marriage squeeze. Several scholars have proposed definitions and measurements of the marriage squeeze. Akers (1967), Muhsam (1974), Goldman, Westoff and Hammerslough (1984) and Schoen (1983) were the first to make a quantitative assessment of the marriage squeeze. Although using different approaches to measure the marriage squeeze, they validated the importance of mate availability for marriage behavior, especially for age at marriage.

Despite the surplus of women, marriage rates and age at marriage also decreased for men during the 1970s, which could not be explained by the marriage squeeze. According to Guttentag and Secord (1983), the basic marriage squeeze hypothesis fell short because it ignores the psychological, economic and social conditions that moderate the simple rules of supply and demand. In their book *Too many women? The sex ratio question*, they provide a theoretical framework on how an imbalance in the number of men and women influence gender roles and partnering behaviour. This perspective, known in the literature as the *sociocultural perspective or the imbalanced sex ratio perspective*, assumes that men and women react differently to sex ratio imbalances. Because men mainly are in control of structural power, marriage is less a matter of urgency for men than for women. As a result, an abundance of mate availability is expected to discourage men to commit to one woman while a shortage of women is expected to encourages men to make and keep that commitment. In other words, Guttentag and Secord (1983) posit a different reaction to the marriage squeeze for men and women: when there are fewer men than women, expected marriage rates for women are low but the rates for men are expected to be low as well. The latter expectation is in contrast to what is presumed from the gender neutral marriage squeeze hypothesis. Conversely, when women are scarce, marriage rates are expected to be high for women as well as for men. So, Guttentag and Second predicted a positive effect of mate availability on women's marriage rates but a negative effect of mate availability on men's marriage rates.

In the late 1970s and early 1980s, the continuing retreat from marriage, together with the rise of single female headed families among African Americans in the United States, raised new questions. Numerous studies addressed these issues and tried to explain lower marriage rates, higher divorce rates, and higher illegitimacy rates for black women. Some authors argued that most studies failed to make the link with crucial dimensions of the social demography of African American families. Spanier and Glick (1980) as well as Guttentag & Secord (1983) hypothesized that high mortality rates among black men implied that sex ratios for black women were strongly imbalanced. After considering mortality rates, the concept of the marriage squeeze proved to be useful in explaining racial differences in female marriage behaviour.

Wilson (1987) took this a step further and emphasized the desired characteristics of potential spouses instead of the sheer number. He demonstrated that the rise in female-headed families among African Americans was related to increasing joblessness among black males. High black-male unemployment rates combined with high black-male mortality rates reduced the proportion of black men who were in the position to support a family. Wilson (1987) computed the marriage squeeze by dividing the number of employed men by the number of women and referred to this as *the male marriageable pool index*. He showed that a shortage of black men with desirable economic qualities lowered black women marriage rates.

Wilson's contribution revitalized research on the marriage squeeze. The emphasis on the lack of "high quality" black males shifted the argument from availability to suitability. As a result, the marriage squeeze was no longer just a matter of the sheer number of men and women who can potentially form a relationship, but also a matter of suitability in terms of socioeconomic qualities. Beside employment status, other characteristics, such as income level (Lichter et al., 1992; 1995) and educational level (Goldman et al., 1984; Schoen & Kluegel, 1988; South & Lloyd, 1992) were introduced as relevant dimensions of "the quality" of men.

Apart from Guttentag and Secord (1983), Oppenheimer (1988) provided a major new theoretical framework on how population composition influences the timing and likelihood of marriage. She stated that whether and when a mate is found depends on the efficiency of the selection or search process. This efficiency is determined by the number of potential suitable partners and by the knowledge about their suitability. Her *marital search theory* contradicted the conventional wisdom that the continuing retreat from marriage could be ascribed to the masculinization of women's economic life and that women's enhanced economic opportunities reduced the financial incentives to marry. Instead, she suggested to focus not

only on men's but also on women's economic qualities and mate selection preferences (in contrast to the perspective on union formation by Becker (1981) which focused on the exchange of men's work on the labour market with women's unpaid domestic work).

After Wilson's and Oppenheimer's contributions, the next step was to connect the marriage squeeze hypothesis with patterns of assortative mating. First, Lichter, Anderson and Hayward (1995) questioned whether a shortage of marriageable men not only changes marriage rates but also changes the characteristics of the men women marry. They stated that when faced with a deficit of eligible men, women do not lower their marital preferences and marry men with low socioeconomic status, but rather choose to forgo marriage. Second, Albrecht et al. (1997) argued that although men prefer economically attractive women, they are not eager to marry women who greatly outrank them in education and women remain doubtful about marrying men with a lower educational level than themselves. Third, Qian (1998) concluded that owing to the rising number of highly educated women in the marriage market, educational hypogamy (women marrying down) has exceeded educational hypergamy (women marrying upwards). Finally, Lewis and Oppenheimer (2000) argued that local mate availability, rather than imbalanced sex ratios, influences educational sorting, and they found that the higher the concentration of equally or more highly educated potential mates, the lower is the likelihood of marrying down. Also Esteve, Garcia-Roman and Permanyer (2012) showed that the *index of female educational advantage* (see further p.11) is associated with the prevalence of hypergamy.

In this strand of research, scholars have focused extensively on education. A major reason is its correlation with the socioeconomic status as well as with cultural and lifestyle preferences (Kalmijn, 1991) and the implied impact on partner choice and the subsequent union dynamics (Qian & Preston, 1993; Lewis & Oppenheimer, 2000). Recent decades have witnessed a substantial change in the distributions of educational attainment in the population at marriageable age. This should be taken into account when investigating the determinants of family formation today.

Of course, many other factors play a role in the selection process, such as physical attractiveness and other social, cultural or economic factors. However, measurements of these factors are often not available, while distributions by age, educational level, marital status and region usually are readily available. To handle the unknown, Fossett and Kiecolt (1991) posit that it is reasonable to assume that individual characteristics like physical attractiveness are distributed randomly within key socio-demographic subpopulations. To define the set of

suitable mates, groups defined by age, educational level, country and marital status are used to set an upper limit on the number of potential partners.

As the previous overview implicitly suggests, most influential contributions on the marriage squeeze have focused on the USA. Recently, however, attention has shifted towards Asian countries, which typically show a more dramatic imbalance in the sex ratio (Rallu, 2006; Jiang et al., 2013; Francis, 2011). Especially in China, the abundance of boys is anticipated to have profound and far-reaching consequences (Trent & South, 2011; Tucker & Van Hook, 2013). To our knowledge, the number of studies addressing Europe is very limited and the available work tends to focus on one single country (e.g., Abrimitzky, 2009; Fraboni & Billari, 2001). In this paper, we aim to expand the scope to a broad range of European countries.

## 3. Methods for quantifying the mating squeeze

Several authors examined how to appropriately define and measure the marriage squeeze. These measures can be divided into two broad categories: the first and most common approach is based on sex ratios (Akers, 1967; Goldman et al., 1984; Fossett & Kiecolt, 1991), the second is based on the harmonic mean consistency condition introduced by Schoen (1981). This section first outlines Schoen's approach and subsequently discusses the sex ratio approach in more detail. Schoen's approach is not often applied, probably due to very strong data requirements. Given that the necessary data are not available for a broad range of European countries, we do not go into the details of this. Instead, we focus on measures based on sex ratios.

### 3.1 The two-sex problem and Schoen's harmonic mean consistency condition

The measures based on sex ratios reflect imbalances between numbers of men and women with specified marriage-relevant characteristics. These measures have been used frequently to explore implications for family related outcomes such as marriage rates, marital and non-marital fertility or marital instability. By contrast, Schoen (1983) provides an approach to the marriage squeeze which is closely related to what is called the two-sex problem. This two-sex problem can be explained as follows.

Consider a set of observed age-specific male marriage rates and a second set of observed age-specific female marriage rates. For these rates to consistently reflect the behaviour of a population, the number of marriages implied by male rates must be equal to the

number of marriages implied by female rates (Schoen, 1981). The observed marriage rates are influenced not only by the age-sex composition of the male and female populations, but also by the preferences for opposite-sex partners with a given age. Consider a set of marriage rates, given the number of males aged *x* marrying females aged *y* equal to the number of females aged *y* marrying males aged *x*. If we multiply the male rate for (*x*,*y*) marriages by the male population aged *x* in a second population with a different age-sex composition, we will obtain a hypothetical number of (*x*,*y*) marriages (call this $N_m$), based on the rates observed in the first population and the population composition of the second one. However, by multiplying the female rate for (*x*,*y*) marriages by the number of females aged *y* in the second population we will obtain a hypothetical number of (*x*,*y*) marriages (call this $N_f$), which will be different from the hypothetical number $N_m$ implied by the number of men age *x* (Schoen, 1983). This is called the two-sex problem.

To reconcile these inconsistencies, Schoen (1981) provides an harmonic mean consistency condition, later used to define a marriage squeeze index. To do so he introduces the notion of rectangular population, which has the same number of persons in each age-sex group and is therefore free from marriage squeeze. In other words, since the initial size of the male and female cohorts does not change and given fixed marriage preferences and mortality rates, period and cohort experiences are constant in the rectangular population and the number of males who marry is equal to the number of females who marry. Therefore, if we consider a two-sex nuptiality-mortality life table, determined by the given set of marriage preferences and mortality rates and by the initial size of male and female birth cohorts, it is possible to measure the marriage squeeze as the difference between male and female observed marriage rates relative to the total number marriages in a population without any marriage squeeze (i.e. the number of marriages derived from the rectangular population). Given fixed underlying preferences, this approach implies that the age-sex composition of the population affects the number of marriages in a twofold way: directly, with the change in the age-sex distribution assuming fixed male and female age specific marriage rates (this can be interpreted as a one-sex composition effect); and indirectly, through the change in the male and female age-specific marriage rates induced by the change in the age-sex distribution (Schoen, 1983).

Applications of Schoen's approach have focused on the indirect effect (i.e., the change in the marriage rates due to two-sex composition effects), so they measure the marriage squeeze as the change in age- and sex-specific marriage rates produced by changes in the age composition of the populations of each sex (Schoen, 1983; Schoen & Kluegel, 1988; Qian & Preston, 1993; Qian, 1998; Fraboni & Billari, 2001; Raymo & Iwasawa, 2005). Sex ratios are

instead used by demographers to capture the total effect (direct plus indirect) produced by the observed imbalance in the numbers of men and women with specific marriage-relevant characteristics that people consider when looking for a partner (Fossett & Kiecolt, 1991).

The empirical application of Schoen's two-sex approach requires appropriate data showing numbers of marriages cross-tabulated by the ages of the bride and the groom. These data are typically not available for cross-country comparison. Since this paper aims to reconstruct past and ongoing trends of the education-specific mating squeeze for a broad range of European countries, we will stick to measures based on the sex ratio. However the comparison between these alternative approaches to the measurement of the marriage squeeze should be further explored in more detailed studies addressing one or just a couple of countries.

### 3.2 Measures based on the sex ratio

In demography, the sex ratio is defined as the number of men divided by the number of women and has been computed in a variety of ways, taking into account different marriage-relevant factors, such as age, relationship status, race (Fossett & Kiecolt, 1993; Lloyd & South, 1996; Albrecht et al., 1997; Cready, Fossett & Kiecolt, 1997; Crowder & Tolnay, 2000), income, employment status (e.g., Wilson, 1987; lichter et al., 1991; 1992; 1995), or educational attainment (e.g., Goldman et al., 1984; South & Lloyd, 1992; Lewis & Oppenheimer, 2000). Below we examine more in detail some of these measures based on sex ratios.

Deviation from a ratio of unity, which indicate an imbalance between the number of potential brides and the number of potential grooms, may be caused by a range of factors. For example, a shortage of marriageable men (i.e., a marriage squeeze for women) can occur in countries suffering severe war losses or in countries where men have exceptionally high mortality rates (Jones & Ferguson, 2006; Abrimitzky, 2009). Countries where there is a strong cultural preferences for sons rather than daughters, such as China or Korea, are currently experiencing a marriage squeeze for men (Rallu, 2006; Trent & South, 2011; Tucker & Van Hook, 2013). Sex differences in migration may also lead to an imbalance in the number of men and women at the marriageable ages (Goodkind, 1997; Angrist, 2000; Francis, 2011). In addition, a marriage squeeze may also be caused by fluctuations in the birth rate, as explained in the next section.

### *3.2.1 Age-specific sex ratios*

Because men tend to marry women who are on average two to three years younger, fluctuations in the birth rate cause an imbalance in the number of marriageable men and women twenty to twenty-five years later. When birth rates have decreased over time (and older cohorts are more numerous than younger ones), men will outnumber women at the prime ages of marriage. When birth rates have been rising (and older cohort are smaller than younger ones), women will outnumber men at the prime ages of marriage (Akers, 1967; Muhsam, 1974).

Age-specific sex ratios do not only restrict male and female age intervals (typically to a width of 5 or 10 years), but are often staggered by two to three years to take into account the observed age gap between partners (the mean age difference between spouses has remained relatively stable at about 2 to 2.5 years over the past decades).

A first age-specific measure of the sex ratio was proposed by Akers (1967), to capture the variations in marriage trends in the United States during the 1960s caused by what he calls a "disproportion between the sexes". To delimit the age ranges, he first estimated average annual first marriage rates by age and sex for the period from 1959 to 1964. Then, he defined two age groups, the prime ages of marriage for females (from 18 to 22 years old), and the prime ages of marriage for males (from 20.25 to 25.25 years old), so that the midpoint of each range is close to the median age at first marriage. The age ranges defined include about 60 percent of female first marriage and 50 percent of male first marriage, and they also reflect mean age difference between brides and grooms.

Weighted age-specific sex ratios alter age-specific sex ratios to take into account the likelihood of marriage at each age, and, thus, a broader age range. For a given age-sex group, for example women aged 15 to 24, Akers (1967) computed a weighted sum of men in the age group assumed to be suitable for those women, for example men aged 15 to 29. The weights reflect the probability of marriage or the strength of preferences for a mate of a given age (Akers, 1967; Fossett & Kiecolt, 1991).

Clearly, there are important consequences arising from the choice of the age range width and the age gap between sexes. The practical implications of using different age intervals will be discussed in more detail in section 4, when we present the results of application to European countries.

### *3.2.2 The Availability Ratio*

The above mentioned sex ratios have been criticized for ignoring the fact that women of a given age will be competing with women in other age groups for the same men (and vice versa). In order to address this criticism, Goldman et al. (1984) proposed a new measure which he called *Availability Ratio*. This measure incorporates information about both the available pool of potential mates and the competition from members of the same sex for that pool. One of the main contributions of this paper, besides the fact that it has extended conventional age-specific sex ratios by taking into account competition, is that it is one of the first methodological studies to include the level of education in the computation of a measure of the mate availability as a factor influencing marriage opportunities.

For a woman of a given age (or age group) and educational level, the Availability Ratio is defined as the number of suitable men available to this woman divided by the average number of suitable women available to her potential partners:

$$AR = \frac{\sum_j \sum_i M_{ij}}{\frac{\sum_j \sum_i W_{M_{ij}} M_{ij}}{\sum_j \sum_i M_{ij}}} \quad (1)$$

where $M_{ij}$ is the number of suitable men age $i$ in educational level $j$; $W_{M_{ij}}$ is the number of women suitable for the $M_{ij}$ men. The denominator in the previous equation can be then interpreted as the competition by women for the $M_{ij}$ men in the numerator; it is the average number of suitable women for the $M_{ij}$ men. The interpretation is similar to that of the traditional sex ratio. A value of the availability ratio greater than unity implies an excess of men and, hence, a marriage market favourable for women. Ratios less than unity indicate a deficit of men, meaning an imbalance in the mating pool to the disadvantage of women. When any randomly selected woman has one suitable man and that man has only one suitable woman, then the AR is equal to one.

The AR as presented here is computed from the female perspective, but it can easily be calculated for men by simply reversing the sexes. Also, additional or alternative criteria for suitability can be added, like race, or criteria can be removed from the computations. If only age is considered, all elements with subscripts *j* in equation (1) can be removed.

As pointed out by the authors, the AR is not equivalent to the probability of the arbitrary woman to marry (since her pool of available men has several suitable women from which to choose for a mate, she is not certain to marry), but it can be interpreted more as the chances of that woman to find a mate.

Despite several conceptual advantages, the practical returns of complex measures like the weighted-age specific sex ratio and the availability ratio over simpler sex ratio measures has not become evident. Both methods imply assumptions about a variety of age constraints, generally inferred from the observed percent of recent marriages for each age of bride. These constraints should reflect the age preferences of the spouses concerning their propensity to marry younger or older partners under favourable condition, e.g. with the same numbers of men and women in all ages. However, in reality, people may adapt age preferences in response to unbalanced mating pools, and this imbalance in turn is the result of customs and changes in preferences. Consequently, trying to define a realistic set of age constraints to incorporate into a measure of mate availability is a debatable procedure, which may also lead to an *endogeneity problem*. In this context, this problem arises when a measure that is supposed to be a determinant of an outcome actually reflects that outcome itself.

Moreover, past studies have reported basically the same results, irrespective of whether conventional sex ratios where used or the more sophisticated weighted sex ratios and availability ratios. In a methodological review of sex ratio measures, Fossett and Kiecolt (1991) found weighted sex ratios and availability ratios empirically less adequate than broader sex ratios in registering the imbalance between potential mates and the competition for them. South and Lloyd (1992) indicate several conceptual advantages in using the availability ratio but in general the findings based on less sophisticated measures of mate availability are quite similar to those for the availability ratios. Albrecht et al. (1997) did not find significant variations in their results when comparing the crude sex ratio and the availability ratio to study women preferences in educational homogamy. Goldman et al. (1984) concluded that the unweighted availability ratio is interchangeable with the weighted availability ratio.

In sum, more complex measures derived from sex ratios might entail endogeneity problems while they seem to be of limited added value in empirical research. We therefore will refrain from using them in our own research.

### 3.3 Alternative measures of mating market opportunities by education

The following two approaches offer alternative ways of measuring socio-demographic characteristics of the mating market that may affect rates of (assortative) union formation. These measures have affinity with the approaches based on sex ratios even if they do not strictly contain a sex ratio.

### *3.3.1 Educational concentration*

Lewis and Oppenheimer (2000) examine educational assortative mating and marriage behaviour from an alternative perspective. They shift the focus from sex ratios to marriage market concentration. Instead of the sex ratio approach they follow a structural approach which emerged from the sociological literature. This approach is concerned with social heterogeneity and with how small groups (i.e. local marriage markets) might affect intergroup contacts. The variable of interest then becomes the relative group size instead of the measurement of the imbalance between potential mates who possess a given feature. In fact, even with a perfect balance between men and women, people may still face difficulty in finding an appropriate partner if the group of similar potential mates is small relatively to the group of dissimilar mates, and this is especially true when considering partners' educational level. In order to measure local mate availability from this alternative perspective, Lewis and Oppenheimer (2000) introduced a measure called *marriage market educational concentration*. This is the proportion of age-matched potential partners with at least as much education as the reference person. For each person of age (or age group) *i* and educational level *h*, we calculate:

$$\frac{\sum_i \sum_{j=h}^{J} M_{ij}}{\sum_i \sum_{j=1}^{J} M_{ij}} \; or \; \frac{\sum_i \sum_{j=h}^{J} F_{ij}}{\sum_i \sum_{j=1}^{J} F_{ij}} \tag{2}$$

where $M_{ij}$ and $F_{ij}$ are numbers of single males and females, respectively, of the specified age *i* and education *j*, and *J* representing the maximum level of educational attainment. The conceptual difference between this measure and the traditional sex ratio is that while the latter reflects competition or imbalance between women and men of a specified age and education, the concentration indicates the possibility to find an equally or more educated partner and, thus, the chance of marrying up on education.

### *3.3.2 Index of female educational advantage*

To explore the connection between the decreasing trend in hypergamy and the observed general increase in female educational attainment, Esteve et al. (2012) proposed a measure of *female educational advantage*. The index represents the probability that the educational attainment of a woman picked randomly from the population is higher than the education of a man picked randomly from the population. It is defined as follows:

$$F = \frac{p_f^3(p_m^1+p_m^2)+p_f^2 p_m^1}{1-(p_f^1 p_m^1+p_f^2 p_m^2+p_f^3 p_m^3)} \quad (3)$$

where $p_f^h$ and $p_m^h$ are respectively the proportions of men and women in educational category $h$ (from 1 to 3). As this index is a probability measure, it takes on values between zero and one. When $= 0.5$ , the educational distributions for women and men are identical, while values above (below) 0.5 indicate an higher level of education for women (men) than for men (women). Therefore, when $F = 1$ ($F = 0.$), no man (women) has an educational level higher than or equal to that of any woman (man).

One of the main advantages of this measure over the education-specific sex ratio is that it takes into account all educational categories, not just one category (e.g., sex ratio for college-educated men and women). This characteristic could be relevant if, for example, we want to measure gender inequalities in education among different countries, especially among non-Western countries, but may be too broad to capture changes on the college-educated marriage market.

## 4. Empirical applications in European countries

In order to reconstruct yearly sex ratios by level of education and partnership situation we use data from the European Union Labour Force Survey (LFS) from 1998 to 2011. The LFS data series actually starts from 1983 onwards, but only from 1998 on it reports consistent information about educational attainment as well as union status. From 1998, the level of education has been harmonized across countries using the ISCED1997 scheme and, moreover, from 1998 the partnership situation can be reconstructed not just in terms of formal marital status but also taking into account unmarried cohabitation. Joan García-Román and Albert Esteve from the *Centre d'Estudis Demogràfics* (Barcelona, Spain) were able to construct in a consistent way a variable in the LFS that allows us to distinguish between adult persons living as singles, in unmarried cohabitation, or married. In particular, information is collected about the absence or presence of a cohabiting partner in the household, that, together with the evidence from the marital status, allow us to determine and distinguish singles from cohabitors.[1] The following variables will be used: gender, age, calendar year, level of education, country and union status. Through the comparison of the results obtained from different data sources, we will check the consistency of the estimates. In all cases, we

[1] The variable, namely the "sequence number of spouse or cohabiting partner" is present in the survey since 1983, but only from 1998 we dispose of these data. It was introduced to reflect the "de facto" situation in terms of cohabitation arrangements and it's used to determine the household type, distinguishing between legal and consensual union.

calculate sex ratios from age 25 onwards, since at this age the majority of the population is assumed to have reached the final level of educational attainment.

### 4.1 Age and the age gap between partners

The essence of the mating squeeze hypothesis is the idea that changes in the age-sex composition of the population influence rates of union formation. Because people prefer to match on age, mating opportunities are restricted by age. Sex ratio measures are usually designed to include certain constraints on the ages of potential men and women, reflecting persistent patterns of age at marriage and age differences between partners. Because men tend to match with women who are on average 2 to 3 years younger, age ranges for men and women are often staggered.

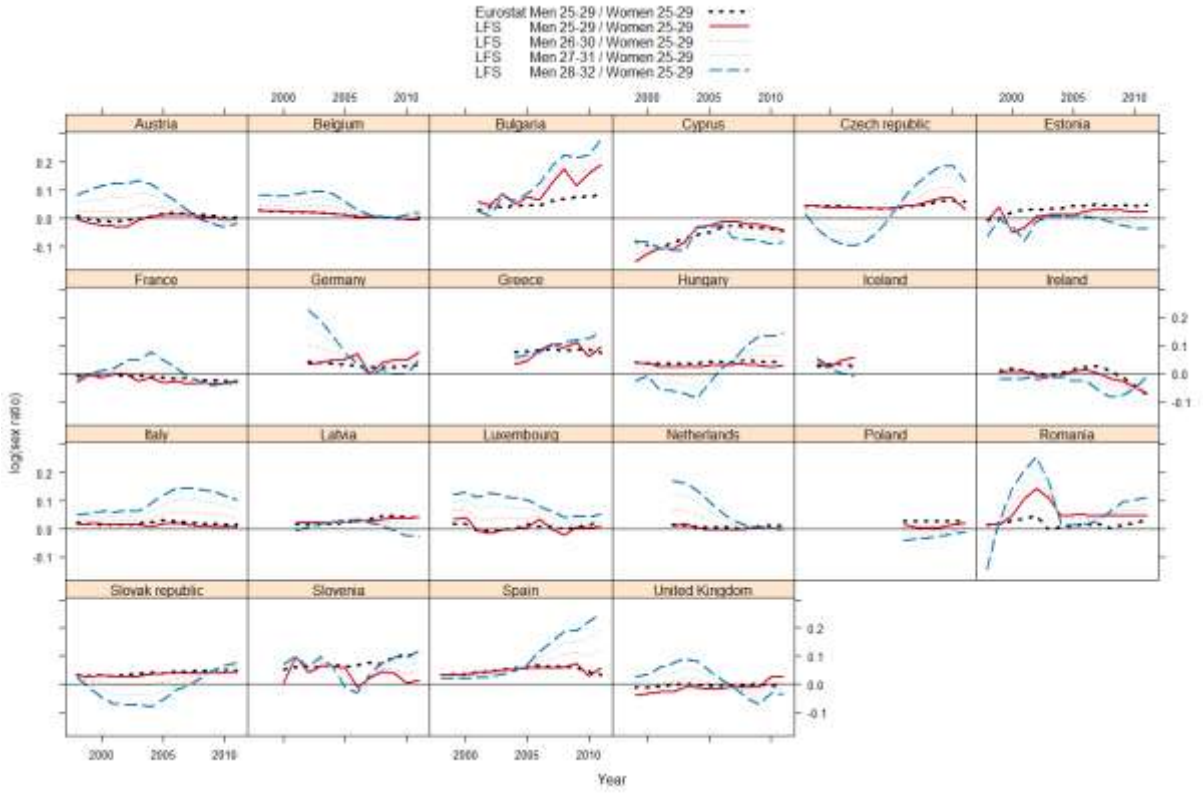
Figure 1 presents five time series of age-specific sex ratios. The first series represents the sex ratio of 25- to 29-year old men and women calculated from the official Eurostat population statistics. This series represents a baseline against which to compare the LFS estimates. Four series are estimated from the LFS, using four different age ranges for men in the numerator (while always counting the number of 25- to 29-year old women in the denominator), reflecting the fact that women tend to mate with somewhat older men. Since the available international LFS database only publishes ages of the respondents in five year age intervals (rather than one year age intervals), we cannot directly count the number of 26, 27, ... year old men. Instead, we estimated the numbers of men aged 26 to 30 year old by taking 4/5 of the number of men aged 25 tot 29 and adding 1/5 of the number of men aged 30 to 34. Similarly, for estimating the number of men aged 28 to 32, we took 2/5 of the number of men aged 25 to 29 and added 3/5 of the number of men aged 30 to 34.

Two conclusions can be drawn from Figure 1. First, there are a number of countries where LFS estimates deviate considerably from the Eurostat population data: there is a systematically different trend in Bulgaria and Slovenia; for Romania, the LFS sex ratio is systematically higher than the Eurostat baseline; there are smaller but noticeable differences also for Germany and Estonia. The match is remarkably good for Belgium, the Czech Republic, France, Hungary, Ireland, Italy, Latvia, the Netherlands, Slovakia, and Spain.

Second, the sex ratios fluctuate more and tend to be more skewed as the age difference between men and women increases. Those fluctuations are caused by several demographic factors, including gender differences in mortality and migration, but notably also by fluctuations in the birth rate, 25 to 29 years ago. In the absence of any fluctuations in the birth rate, in case of constant cohort size, changes in the sex ratio are a function of gender

differences in mortality and migration. Because men have higher mortality rates, sex ratios of older men to younger women have lower expected values than ratios that do not use age differences between sexes. The larger the age difference that is taken into account, the lower the expected sex ratio in case of constant cohort size (Goldmand et al., 1984). However, in Figure 1, the ratios of somewhat older men to somewhat younger women tend to be higher than the ratios of men and women of equal ages (compare the dashed blue lines with the solid red lines, respectively). This is the expected result in case of declining birth rates. When birth rates are declining, the number of somewhat older people (i.c., men) is higher than the number of somewhat younger people (i.c., women); hence the ratio of the former to the latter is higher. This explains that the ratio of men aged 28-32 to women aged 25-29 is higher than the ratio of both men and women aged 25-29 in most countries and years.

*Figure 1. Time series of age-specific sex ratios for different age gaps, irrespective of union status, Labour Force Survey (LFS) estimates versus Eurostat population data, 1998-2011 (log-scale).*




Source: Eurostat harmonized LFS, data prepared by Joan Garcia-Román & Albert Esteve, own calculations

The example of the Czech Republic is most instructive for illustrating this. When age differences are not taken into account, the sex ratio follows a flat line between 1998 and 2011 (solid red line). When we incorporate the fact that men tend to be somewhat older than their

female partners, the corresponding sex ratio first decreases and then increases again (dashed blue lines). The latter oscillations correspond with the fact that 25 to 29 years earlier, between 1969 and 1975, the crude birth rate was on the rise in the area currently known as the Czech Republic. After that, the birth rate started to decline. A similar story applies to Hungary. By contrast, the trends for the United Kingdom exhibit the opposite movement: between 1969 and 1977 the birth rate was decreasing while after 1977 it was increasing. This translated, 25 to 29 years later, into a rising sex ratio first and into a declining ratio later on, but only when taking into account the age gap between men and women.

In sum, sex ratios that take into account an age gap between men and women, so counting men a bit older than women, fluctuate more than sex ratios that count men and women of exactly the same age group. The reason is that fluctuations in cohort size, to a large extent determined by fluctuations in the birth rate 25 to 29 years earlier, add variability to the former type of sex ratio that is absent in same-age sex ratios. Given that it is a very persistent empirical fact that male partners tend to be a couple of years older than female partners, we recommend using sex ratios that take this age gap into account. Failing to take differences in age between spouses into account might smooth away important fluctuations resulting from changes in cohort size. Ignoring the age difference between the sexes would imply that we neglect a major component potentially causing a mating squeeze.

### 4.2 Broad or narrow age ranges?

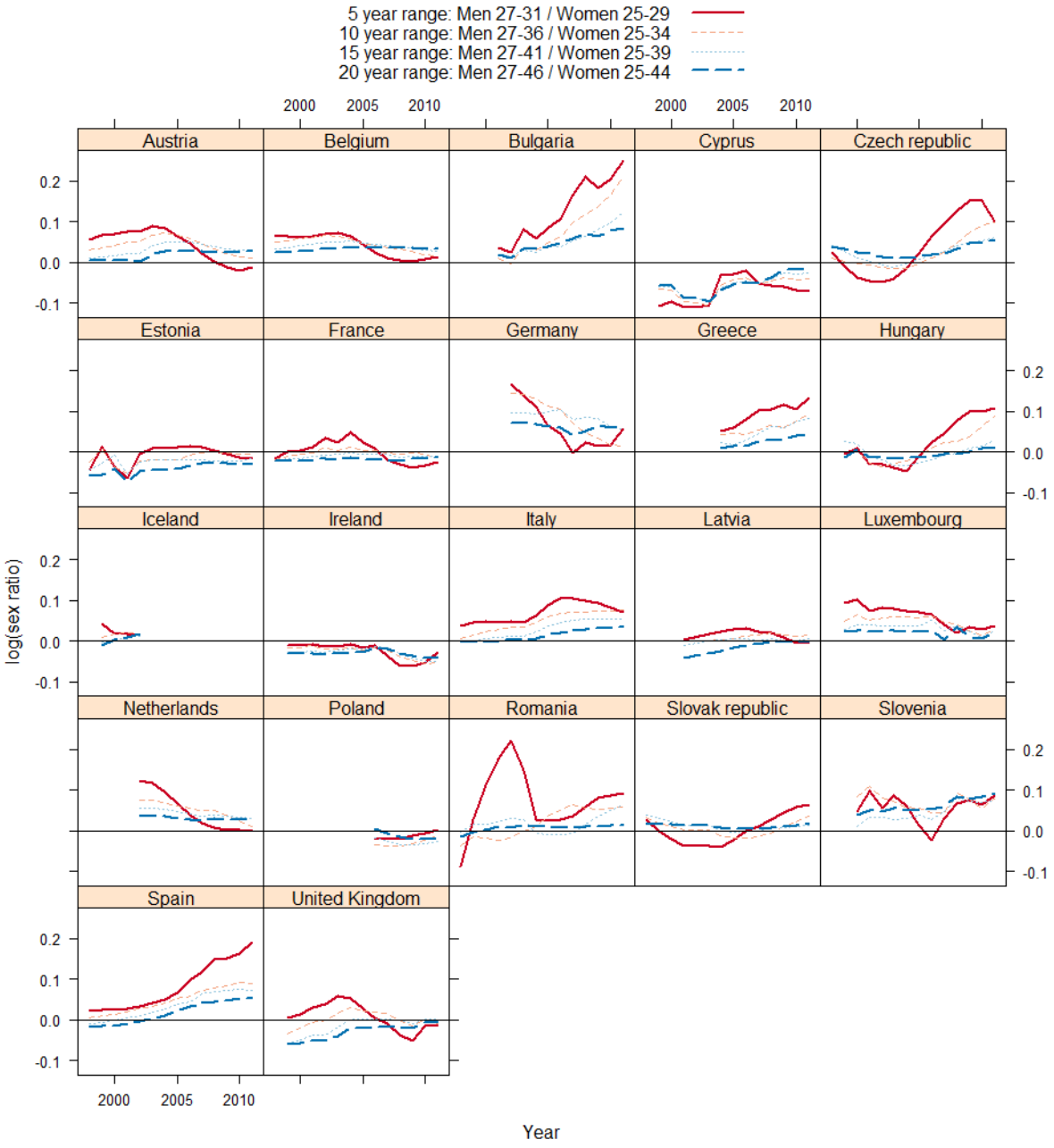
There are no clear *a priori* theoretical reasons for picking a specific age range when calculating sex ratios. The only general and obvious guideline is that children and the elderly should be excluded from the computations when the primary goal is to study family formation. Most age-specific sex ratios are computed using a five-year age span (Fossett and Kiecolt, 1991). For example, Lewis and Oppenheimer (2000) consider that women tend to choose men who are up to two years younger or up to three years older, while men rather tend to pick women who are three years younger to two years older. In line with this, the sex ratio for men and women aged 28 will be computed as the number of men aged 26-31 divided by the number of women aged 25-30. Grossbard and Amuedo-Dorantes (2007) compute sex ratios for five-year age groups by dividing the number of all men two years older by the number of all women ages 20-24 or 25-29 (depending on the year of birth). However, some scholars argue that these age intervals are too narrow and they prefer to extend the intervals to 7-years (Lloyd & South, 1996) or 10-years (Lichter et al., 1992; Esteve et al. 2012).

In general, the age range should be neither too narrow nor too wide and appropriate to the research situation. Fossett & Kiecolt (1991) recommend age range 20-45 as generally suitable for studying family formation. However, too broad measures may not be able to capture the real effects that may be at work within specific age groups. In contrast, too narrow measures may fail to account for the fact that people may look in adjacent age categories when they do not find a mate in their own age group.

Figure 2 shows time series of sex ratios, staggered by two years to count men in the numerator who are two years older than the women in the denominator. This is done for different sets of age intervals, ranging from a five year to a twenty year age range. Not surprisingly, taking broader age ranges smooths away the oscillations associated with fluctuations in the birth rate. As just explained, whether this is an advantage or a disadvantage, depends on (the assumptions about) the tightness of applicable age norms when picking a partner, thus it may depend on historical and regional context. A clear advantage of broader age groups is that erroneous, erratic fluctuations are smoothed away as well. This will be particularly helpful when sex ratios are reconstructed from data exhibiting substantial sampling error, so when the reliability of the data used is limited. This seems to apply to the LFS data for Romania, where the sex ratios for 2001 and 2002 are extremely high when a 5 year age interval is used – the series derived from the official Eurostat population data, shown in Figure 1, suggests that the ratio might not have been as extreme in those years. The peak in the Romanian series, most likely erroneous, is smoothed away when broader intervals are applied. This becomes even more relevant when additional criteria, like educational attainment, are added to the picture.

The most suitable age interval may also depend on the age and sex of the mate searching persons considered. More particularly, there is evidence that age sorting norms broaden for ageing men. The older the age at which men marry, the more likely they are to marry (much) younger women. Thus, for men marrying at older ages, the mean age differences is higher than the two-year differences. This is not the case for women, where the two to three year age gap seems to remain even up to women marrying at age 50 (Goldman et al. 1984: Figure 1; Veevers, 1988). This type of information can be taken into account when looking at particular age and gender segments of the mating market. For older unmarried cohorts a limited age interval does not capture the demography of the mating market and ignores the asymmetrical nature of mating opportunities and practices in terms of age.

*Figure 2. Sex ratios for different age ranges, in each case with a two year age gap for men versus women, LFS data for European countries, 1998-2011 (log-scale).*




Source: Eurostat harmonized LFS, data prepared by Joan Garcia-Román & Albert Esteve, own calculations

So, suppose that for men, younger and same-age women are considered suitable matches. This seems to imply that the mating market becomes increasingly favourable for ageing men, since the age range of suitable women expands as men age. However, this doesn't take into account that they also face competition by younger men, and that the group of younger men expands as they get older themselves. In order to take that kind of competition into account, Goldman et al. (1984) introduced the Availability Ratio.

The availability ratios, as well as the availability indices by Veevers (1988), extend on age-specific sex ratios by including competition from members of the same sex in other age categories. If we take the example of the 28-year old women, the number of men available is specified as the number of men 26 to 31. But the denominator of a simple sex ratio (say the number of women aged 24 to 29) does not take into account all the competition for those 26 to 31 year old men. A much broader age-group than only women 24 to 29-years old are available to them. This broader group of women ("competing" for the men in the numerator) is typically included in the denominator of an availability indicator. As a result, the availability measures tend to be lower than other marriage market measures.

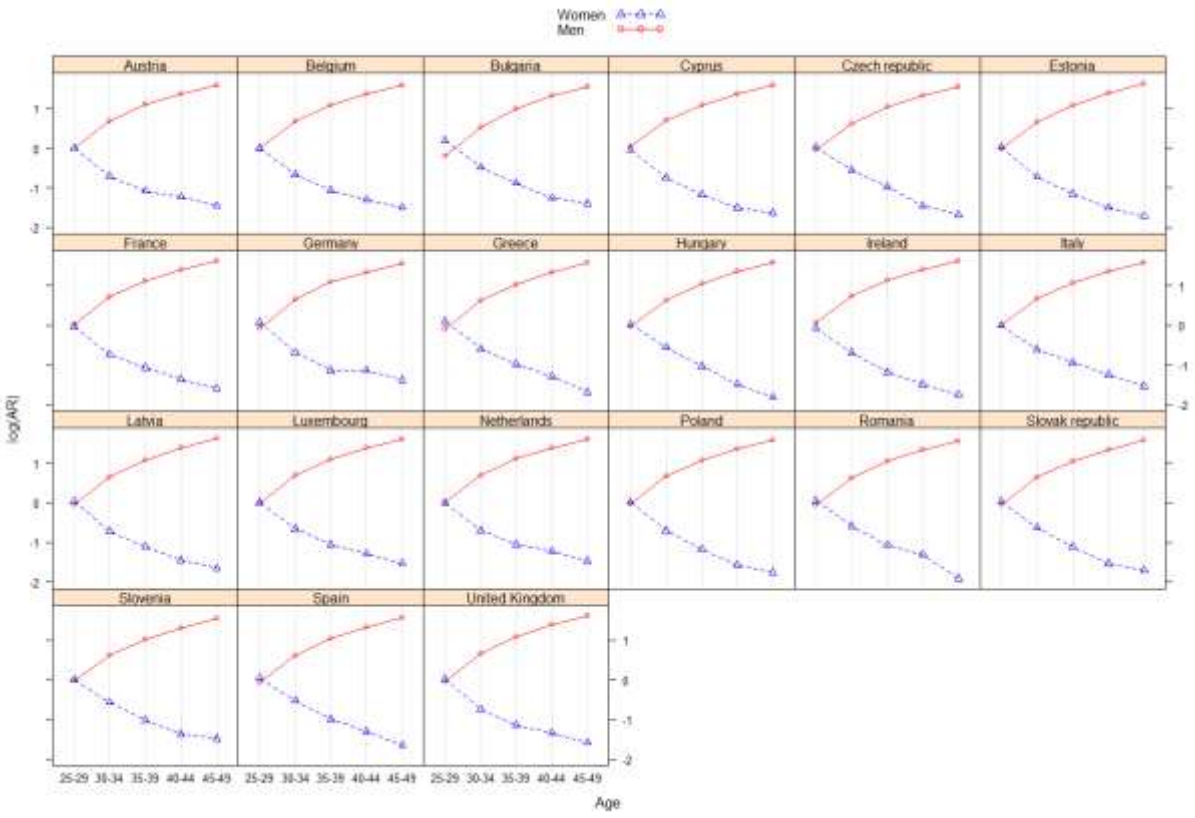
Figure 3 presents AR's when only age and sex are taken into account as criteria for defining suitability; so we have dropped subscript *j* from equation (1) and look only at subscript *i* for age. The AR's for men are calculated such that all women above age 25 are counted as suitable for men as long as they are younger or belong to the same age group as the men at a given age. The AR's for women are calculated on the assumption that men are only counted as suitable by women if they belong to the same age group as the women themselves. Figure 3 shows that such assumptions would imply a balanced availability of potential partners at age 25-29, but with increasing age, the marriage market becomes increasingly unfavourable for women and increasingly favourable for men.

So, after all, the conclusion drawn from the more sophisticated analysis based on AR's confirms the intuition that would come from calculating simple sex ratios. If men perceive younger women as suitable as women of their own age group, then the simple ratio of men of that age group to all same-age or younger women would show the decreasing trend, reflecting the fact that women from a broader age interval are counted in the denominator. The usefulness of doing more complicated calculations for obtaining the AR's is therefore questionable. Also, the results of this approach heavily depend on assumptions about "suitability", and the validity of these assumptions may be questioned as well.

To avoid relying on *a priori* assumptions about suitability, an option would be to use the age distribution of actual brides and grooms, instead of making speculations about the ages that individuals might prefer in marriage, and thus rely on what they actually do. Goldman et al. (1984) included in their AR all ages at which at least two percent of marriages occur. Veevers (1988) specified an age range within which 80% of all marriages for persons of a given age occur. These age ranges are different for men and women. When we take age ranges from the same size and imply a minimum and maximum age, we cover a lower percentage of marriage for grooms. For example Akers (1967) opted for a five-year span

around the median age at first marriage. The range for females was set at 18 through 22 years and covered about 60% of female first marriages. For males the range was set at 20.25 to 25.25 years and covered about 50% of the male first marriages. As an alternative approach, he introduced weighted age-specific sex ratios. For a given reference group, for example women aged 15 to 24, men of all adult age groups are counted. The numbers of men in each age category are then weighted by the proportions of marriages with men of that age. Also Goldman et al. (1984) calculated a weighted version of their availability ratio to take into account that the preferences for a partner of a similar age is higher that the preference of a partner at the extreme of the formulated age range, but the results of the weighted measure of availability was similar to the unweighted measure. An important drawback of these empirically derived marriage market measures is that they not only reflect existing marriage preferences, but also the adjustment to the supply and demand of the marriage market at that time. The validity of relying on those (empirically based) measures is questionable as well.

*Figure 3. Availability ratio (AR) by age and gender, European countries, 2011 (log-scale), assuming that younger as well as same-age women are suitable to men, while only men of the same age group are considered suitable by women*




Source: Eurostat harmonized LFS, data prepared by Joan Garcia-Román & Albert Esteve, own calculations

Summing up, in their methodological review of the sex ratio Fossett and Kiecolt (1991) conclude that computing age-specific sex ratios with and without the two-year age difference, the weighted age-specific sex ratio and the availability ratio are close substitutes for each other at younger ages. At older ages, the mean of the availability ratio tends to be much lower for women compared to other measures. Since all these measures are highly correlated with the crude sex ratio of men to women aged 15-44 and perform as good in their analyses when predicting marriage and family formation, Fossett and Kiecolt conclude that the advantage of computing more refined sex ratio measures is questionable, at least for younger adults in the prime ages for union formation. They actually advise to use sex ratios based on the broad age-ranges 15 to 44, since it does not only measure the number of available mates but implicitly also takes into account the competitors for those available mates. However, for older adults, it may be useful to take into account that marriage market conditions shift over the life course: the circumstances shaping the mating process differ significantly for persons aged 35 to 44 compared to persons aged 25 to 34. This holds even more so when we take into account educational assortative mating. This is considered more in detail in the next section.

### 4.3 Level of education

Age distributions and distributions of educational attainment have changed substantially among the marriageable populations in past decades and several studies have pointed out the impressive increase in female education opportunities and attainment (Shofer & Meyer, 2005). Together with the expansion of higher education among women we can observe a significant decrease in the gender gap in education as shown in The Global Gender Gap Report (Hausmann, Tyson & Zahidi, 2012).

Educational attainment has become one of the most important factors in the mating process (Mare, 1991; Smits et al., 1998; Schwarts & Mare, 2005; Van Bavel, 2012). The traditional pattern of educational assortative mating that we observed so far involved a combination of educational homogamy, female hypergamy and male hypogamy (i.e. women marry men at least as highly educated as themselves, and men marry women at most as highly educated as themselves). This pattern was compatible with the earlier distribution of educational attainment by sex, counting more highly educated men than women. Since this imbalance in education has turned around, this may lead to a new kind of mating squeeze (Van Bavel, 2012).

Given the recent reversal of the gender imbalance in education, we may expect that an increasing proportion of highly educated women and low educated men face increasing

difficulties in finding a suitable partner. In order to measure the dimensions of this education-specific mating and marriage squeeze we will reconstruct time series of sex ratios by level of education in the reproductive ages. We decided to reduce the number of educational categories to three: low (lower secondary schooling or less), medium (upper- or postsecondary schooling completed but no tertiary), and high (first or second stage of tertiary schooling, i.e. university level). This division may seem somewhat crude but it is appropriate for our research scope, which is to show the imbalance of the marriage market participation in particular among highly educated persons. We focus here on the highly educated since this is where most of the changes and differences are occurring – in most European countries, education is compulsory up to the secondary level.

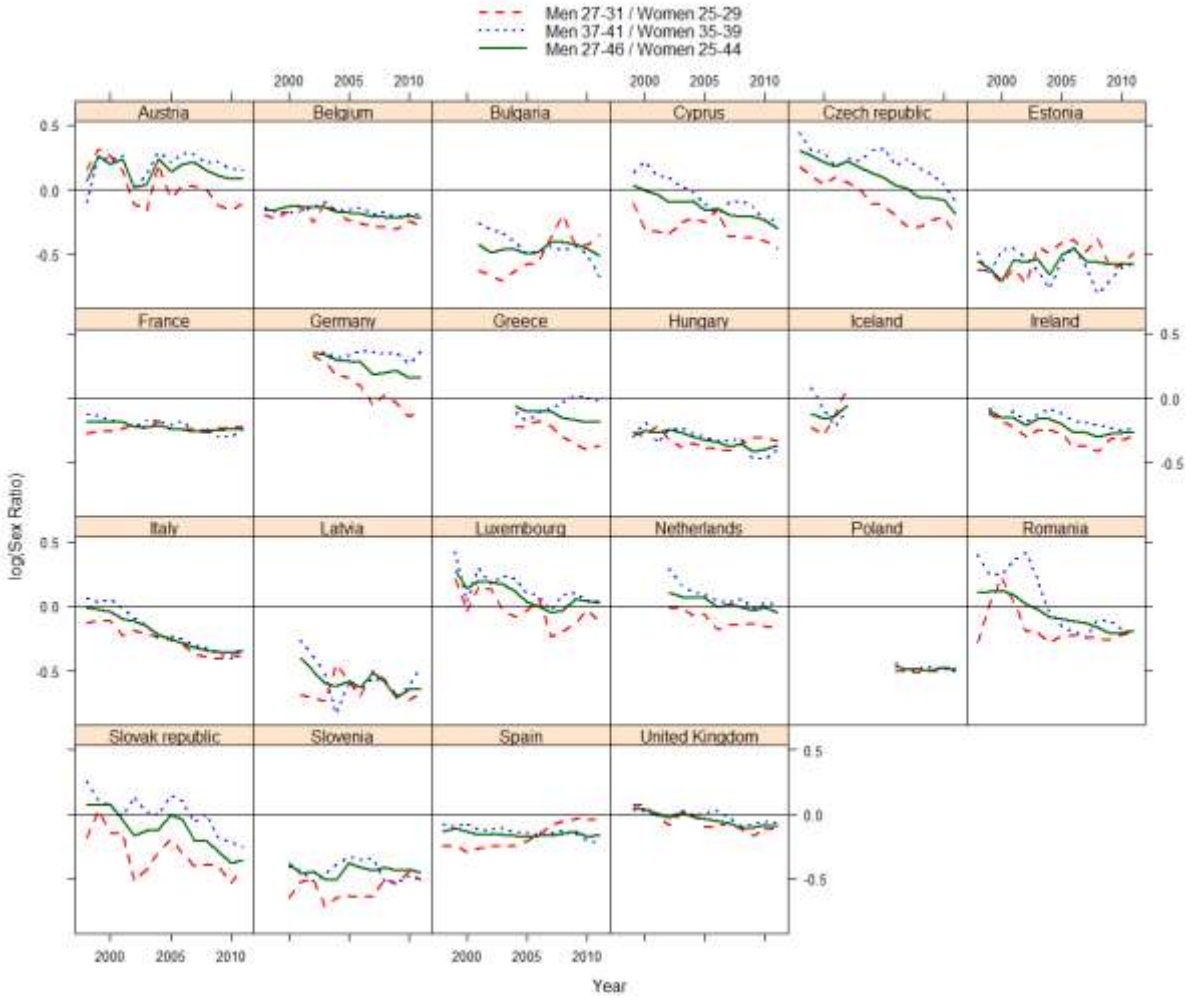
Figure 4 displays time series of sex ratios for the highly educated for three different age intervals: two five year age intervals (women aged 25-29 / men aged 27-31 next to women aged 35-39 / men aged 37-41) and a broad age interval (women aged 25-44 / men aged 27-46). At least three observations stand out. First, as expected, these education-specific sex ratios tend to be lowest for the youngest age group in most countries, in line with the relatively recent reversal of gender inequality in higher education. Second, in most countries, there were already more highly educated women than highly educated men at the start of this time series (i.e., the year 1998), which is in line with longer time series based on other data (see Van Bavel 2012: Figure 1). Third, the time series for the broadest age interval is the most stable one; it exhibits the lowest number of erratic fluctuations. This represents an advantage in case these fluctuations are due to sampling error in the LFS, and it is also in line with the recommendation by Fossett and Kiecolt (1991) to use broad intervals when calculating sex ratios. However, in case the fluctuations in the smaller age intervals would represent real changes rather than errors, using the more stable series for the broad age intervals would miss out potentially important forces affecting union formation. Still, as a general rule, and following the conclusion drawn from previous discussions, we recommend using the broader and more stable age interval.

### 4.4 Union status

In addition to age and education, union status might also be taken into account. Several scholars argue that the ratio of single males to single females is a better measure of the marriage squeeze (Akers, 1967; Muhsam, 1974; Lichter et al. 1992; Lloyd & South, 1996; Lewis & Oppenheimer, 2000; Raymo & Iwasawa, 2005). However, in their methodological review, Fossett and Kiecolt (1991) examined whether sex ratios for unmarried persons aged

15-44 differ from sex ratios for all persons. They concluded that sex ratios computed for unmarried persons do not predict measures of marriage with greater precision than sex ratios for all persons. The only difference is that sex ratios for unmarried persons have slightly higher mean values and greater variability.

*Figure 4. Sex ratios for people with a degree in tertiary education, three different age intervals, European countries, 1998-2011 (log-scale).**



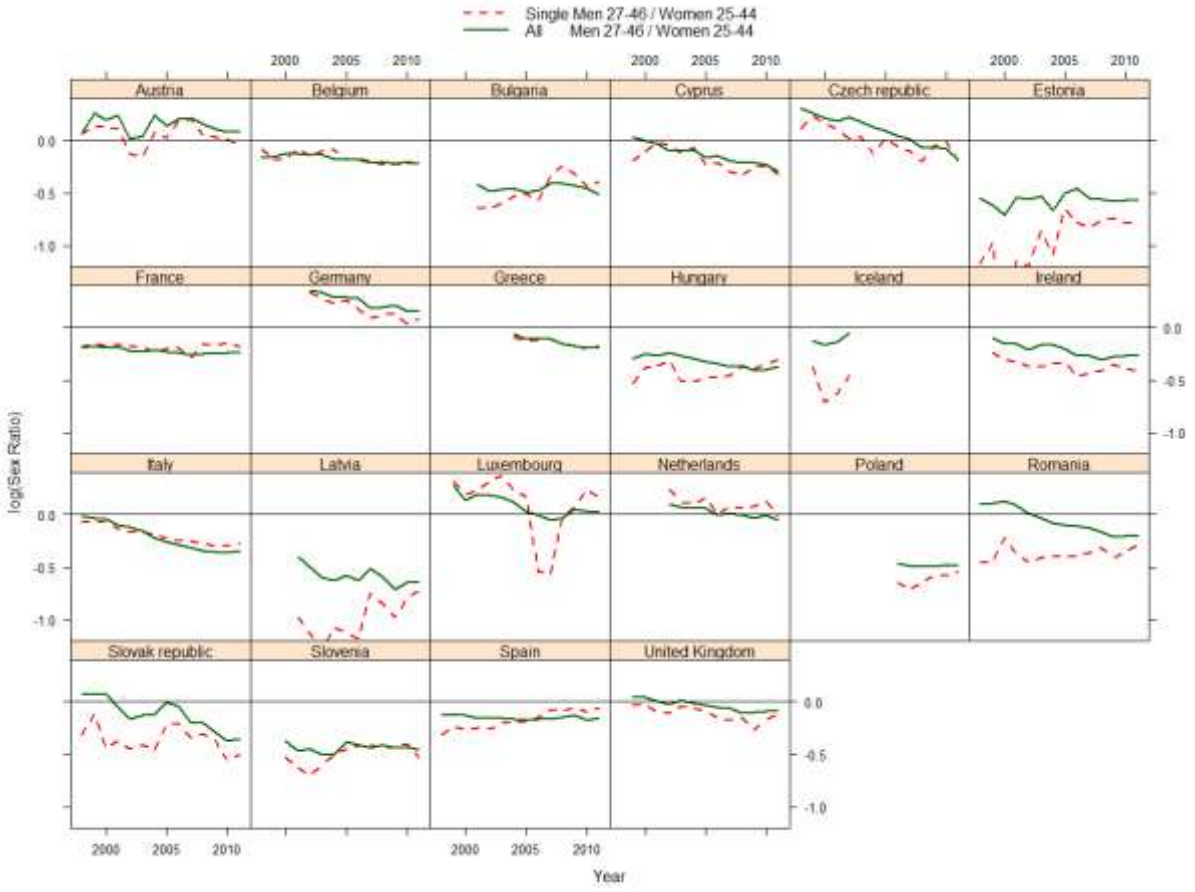

Source: Eurostat harmonized LFS, data prepared by Joan Garcia-Román & Albert Esteve, own calculations

* See the discussion of Figure 1 for the way the numbers in the male intervals had to be estimated

Apart from formal marital status, another issue is how to deal with unmarried cohabitation, an issue of major importance in the European family landscape of today. Goldman et al. (1984) were among the first in the relevant literature to define being single not only as being unmarried, but also as not cohabiting and excluded from their availability ratio also men and women in unmarried cohabitation.

Figure 5 plots time series of sex ratios for a broad age range of people with a degree in tertiary education: men aged 27 to 46 divided by women aged 25 to 44. The solid lines are for all these people irrespective of their union status. The dashed lines are only for people who are single, in the sense of not being in a coresidential union (married or not). Figure 6 gives the same information for younger people (men aged 27-31 / women aged 25-29), and Figure 7 does the same for older men and women (men aged 42-46 / women aged 40-44).

*Figure 5. Sex ratios for people with a degree in tertiary education, singles versus all union statuses, men aged 27-46 / women aged 25-44, European countries, 1998-2011 (log-scale).**



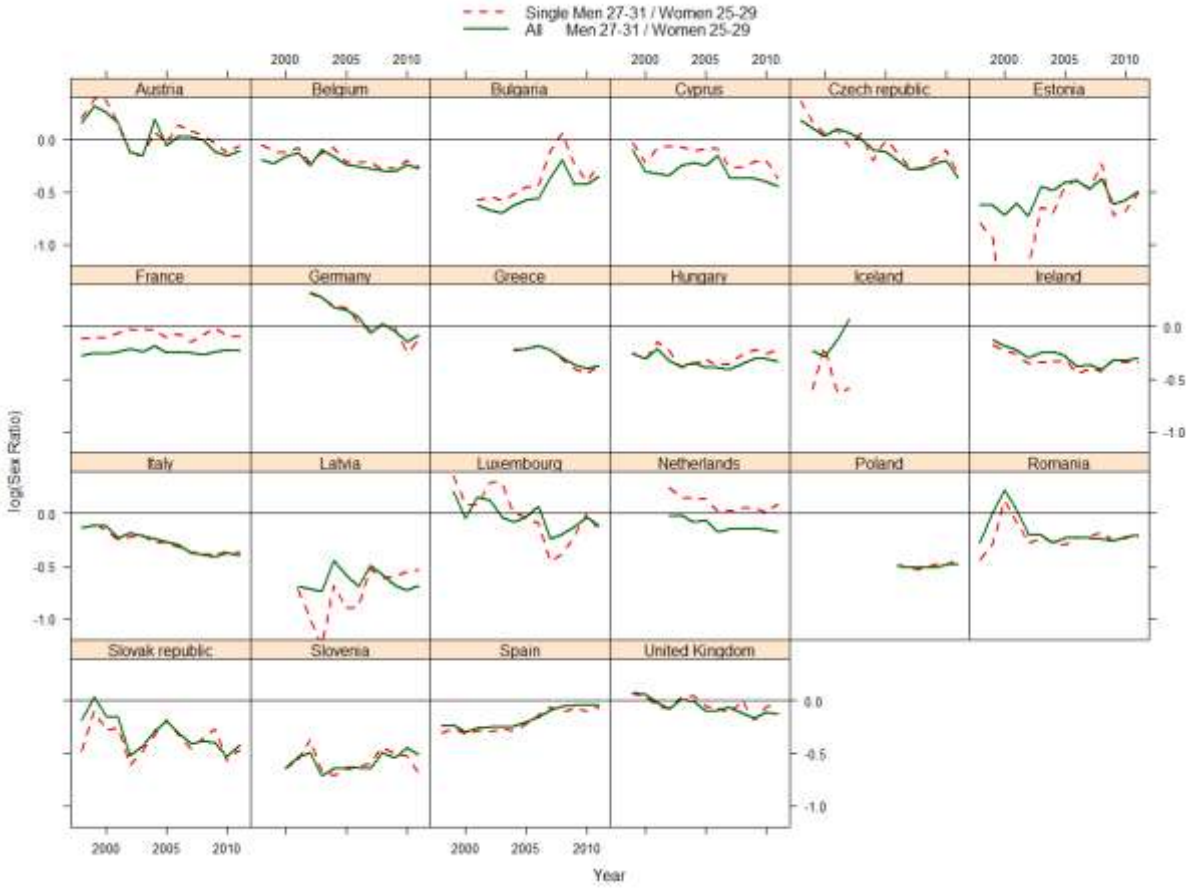

Source: Eurostat harmonized LFS, data prepared by Joan Garcia-Román & Albert Esteve, own calculations

* See the discussion of Figure 1 for the way the numbers in the male intervals had to be estimated

A number of observations can be derived from these figures. First, they confirm the observation by Fossett and Kiecolt (1991) that ratios for singles are less stable. This is probably to some extent due to increasing sampling error as the numbers get smaller. Second, for the younger age group (men 27-31/women 25-29) the sex ratios for singles correspond to the sex ratios for all union statuses. This is also the case when sex ratios are based on broad age ranges, except for Slovak Republic, Romania, Latvia, Estonia, Hungary, Ireland and

Iceland where the sex ratios for singles have lower values, meaning that for highly educated single women sex ratios are even more unfavourable. Third, for the older age group (men 42-46/women 40-44) the sex ratios for singles deviate from the sex ratios for all persons. The sex ratios for singles are in all countries more skewed, indicating that for older (higher educated) single women the marriage market turns out to be more disadvantaged.

*Figure 6. Sex ratios for people with a degree in tertiary education, singles versus all union statuses, men aged 27-31 / women aged 25-29, European countries, 1998-2011 (log-scale).**

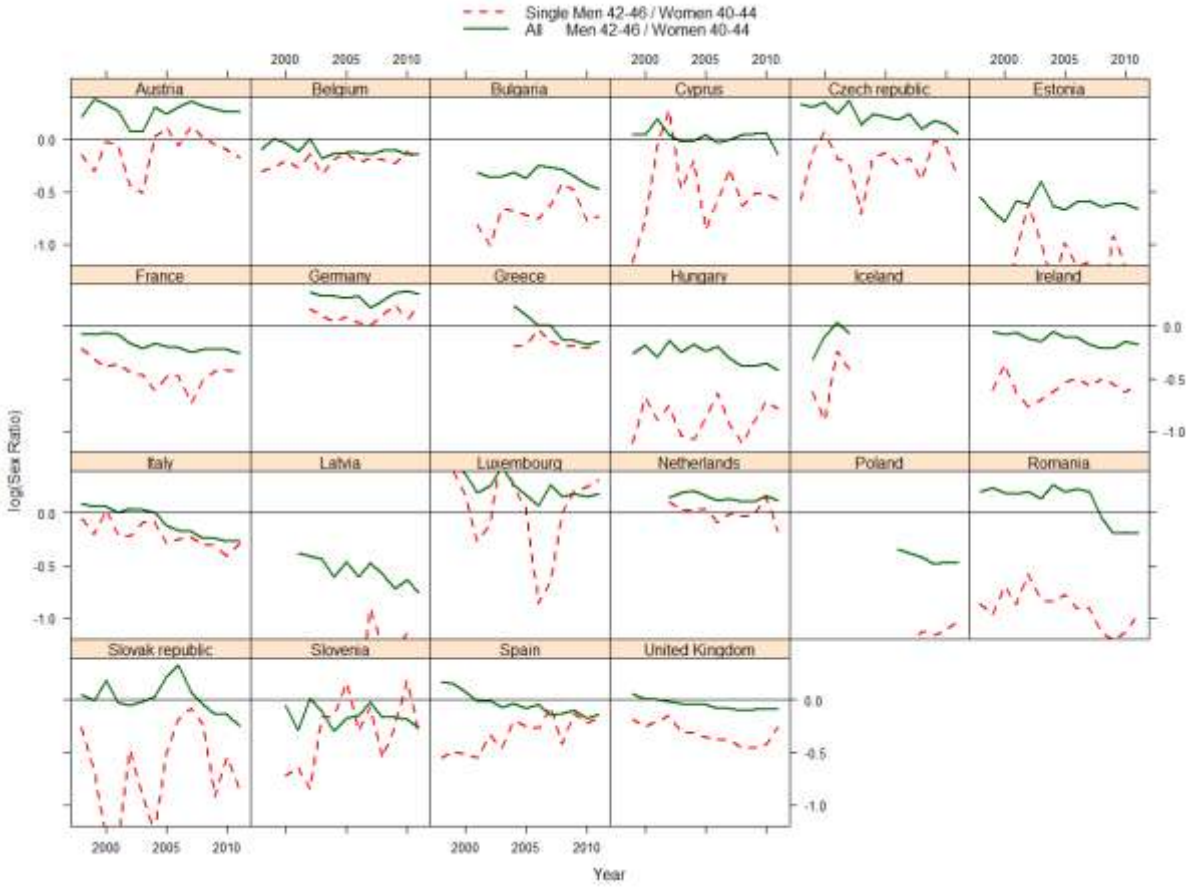



Source: Eurostat harmonized LFS, data prepared by Joan Garcia-Román & Albert Esteve, own calculations

* See the discussion of Figure 1 for the way the numbers in the male intervals had to be estimated

Even if there may be conceptual reasons for excluding those who are currently living with a partner when defining the pool of potential suitable mates, empirical results have shown that sex ratios for single persons are often very highly correlated with sex ratios for all persons. For this reason many scholars found it unnecessary to compute sex ratios for singles only (Fossett & Kiecolt, 1993; Cready et al., 1997; Albrecht et al.,1997; Angrist, 2000; Albrecht & Albrecht, 2001; Grossbard & Ameudo-Dorantes, 2007).

*Figure 7. Sex ratios for people with a degree in tertiary education, singles versus all union statuses, men aged 42-46 / women aged 40-44, European countries, 1998-2011 (log-scale).**




Source: Eurostat harmonized LFS, data prepared by Joan Garcia-Román & Albert Esteve, own calculations

* See the discussion of Figure 1 for the way the numbers in the male intervals had to be estimated

Moreover, using measures of the mating squeeze that include only single men and women may cause problems of endogeneity, when the effect of a sex ratio on union formation is estimated while the sex ratio for singles is obviously, by construction, affected by the rates of union formation and union dissolution. Any statistical association between the sex ratio and the rates of union formation and dissolution will then not just reflect the effect of the mating squeeze on the rate of union formation, but also the reversal causal effect.

### 4.5 Geographic scope

It is not straightforward to delimit the geographic scope of a marriage market. The first studies on the marriage squeeze typically treated countries as marriage markets (Akers, 1967; Muhsam, 1974; Schoen, 1983; South, 1988; South & Trent, 1988). This was often a practical choice, because calculating region-specific rates was often not possible with the available data. However, for a country like the United States, where the majority of the studies took

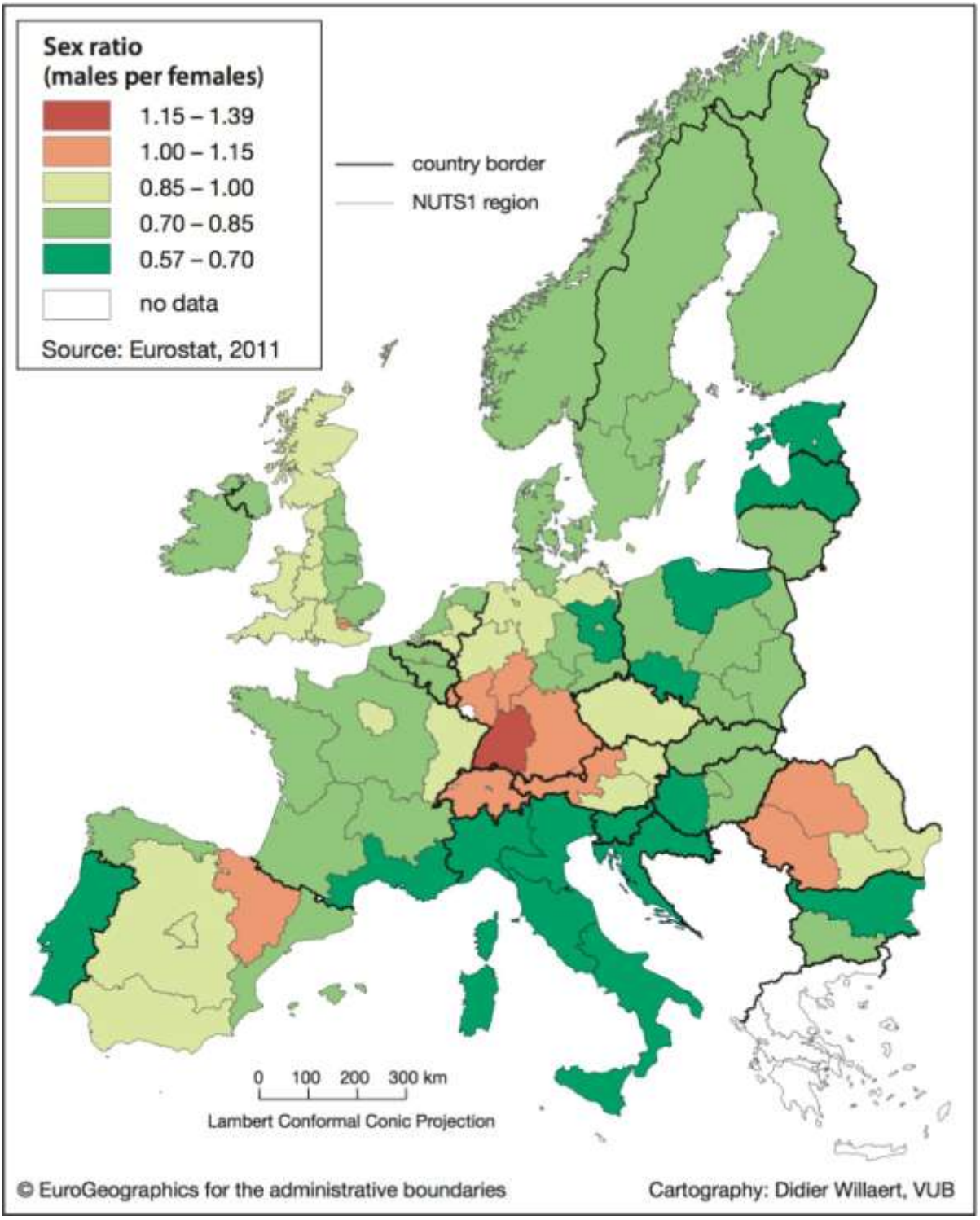
place, this is clearly inaccurate. For illustration, this approach is similar to treating Europe as a single marriage market (if we only consider size and leave the linguistic diversity that exists in Europe aside).

Since marriage markets are limited geographically for numerous reasons, subsequent studies analyzed states (Schoen & Wooldredge, 1989; South & Lloyd, 1992), metropolitan areas (Fossett & Kiecolt, 1993), counties (Cready et al., 1997) or multicounty units like the 382 labour market areas (LMAs) identified in the PUMS-D of the 1980 U.S. decennial census (Tolbert & Killian, 1987). For many scholars the LMAs represent an appropriate geographic scale, because they are not bounded by state lines nor do they only focus on urban centres, but are constructed around the daily journey-to-work patterns. Moreover, LMAs provide an easy way to quantify local marriage markets and to take into account the local economic conditions (Lichter et al., 1991). This is important because regions where primary industries dominate, like Newfoundland, Maine, Montana, and Utah attract many men. Whereas capital cities with a large public sector, such as Ottawa or Washington, attract many women (Hooper & England, 1988; Hamilton & Otterstad, 1998).

In addition, there is a broad range of research that examine alternative ways to delimit marriage markets. Typically, these studies try to capture the settings where potential partners could meet, like the workplace, the neighbourhood, at school or in college (Kalmijn & Flap, 2001; Uecker & Regnerus, 2010). This stems from the idea that the choice of partners is not only affected by preferences and availability of desired traits, but also by the opportunities to meet and interact. However, the search for a partner involves many more dimensions of our life, including friends and family, leisure activities, travel, internet, and many more. The importance of those places varies by context, age and the like. Trying to specify the place of interaction where we encounter our potential spouse is complex and not useful for our objectives.

In order to illustrate the variety in terms of education-specific sex ratios within countries, Figure 8 presents a map with sex ratios for people aged 30 to 34 with a degree in tertiary education for the European NUTS 1 regions (European Commission, 2003). These regions are one level below the country level and allow to distinguish between regions like Flanders and Wallonia in Belgium, or North, Centre, and South Italy.

*Figure 8. Sex ratios for people aged 30 to 34 with a degree in tertiary education, European NUTS 1 regions, 2011*




Overall, the regional education-specific sex ratios tend to be similar within countries. Major exceptions include the southern regions (*Länder*) in Germany, Western Austria, and Northeast Spain: in these regions, there is a male majority of college graduates while there is a female majority in the other regions of the same country. These major deviations need to be

taken into consideration when working on the national level. Apart from that, there is also a remarkable East-West divide in the UK.

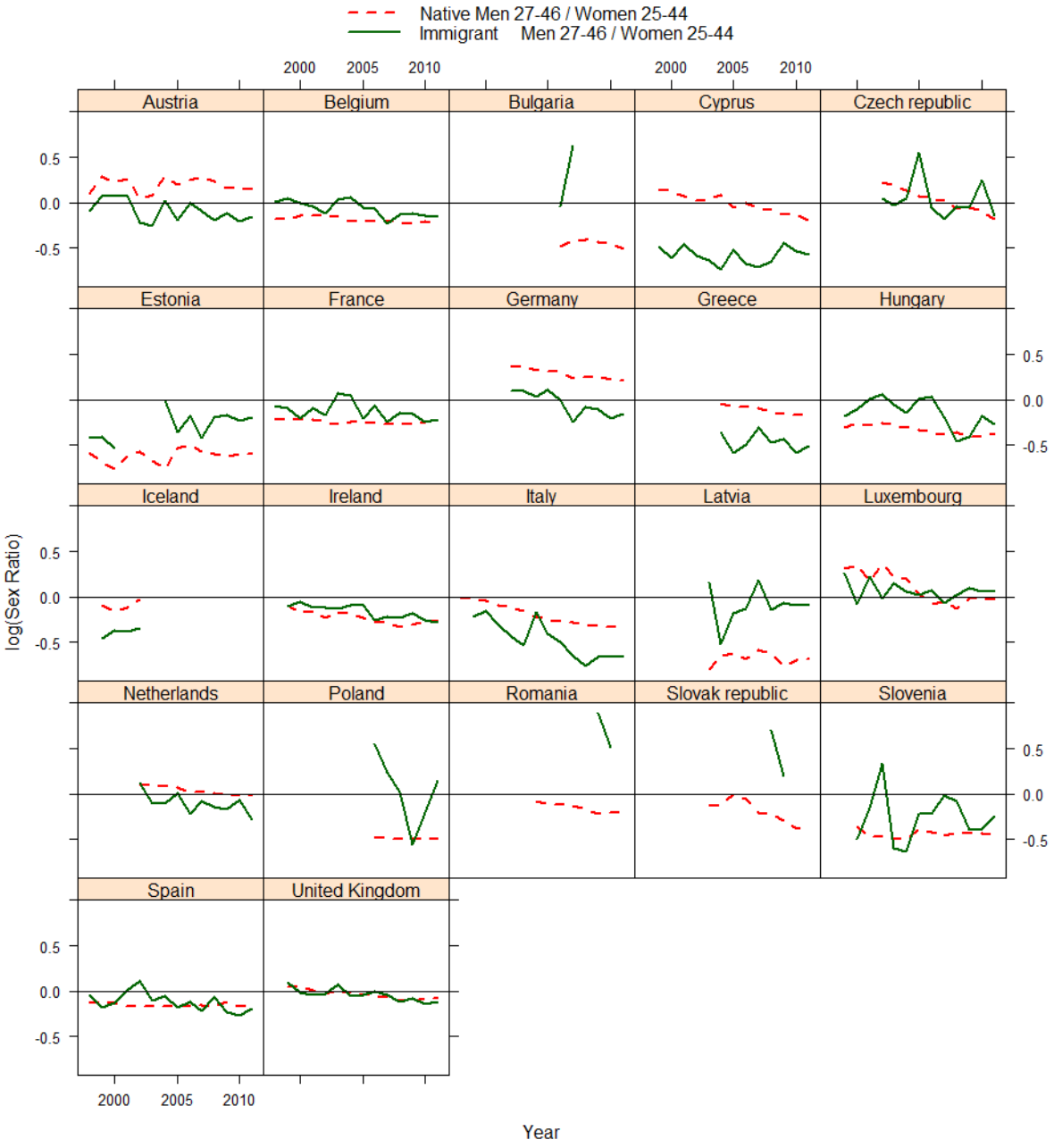
### 4.6 Migrant status

Finally, the LFS also allows us to calculate separate sex ratios for native and migrant populations. These might be useful to assess the role played by this characteristic of the mating market on patterns of ethnic or migrant endogamy and exogamy. Figure 9 presents sex ratios for men aged 27-46 / women aged 25-44 for highly educated natives versus highly educated immigrants. Immigrants are defined as people born outside the country.

For a couple of countries, the number of immigrants in the LFS is so low that the estimates for that group turn erratic. This seems to be the case in Bulgaria, Poland, and Slovenia. Next, there are a number of countries where the sex ratio for the highly educated is systematically higher among the immigrants than among natives. Such is the case in Belgium, France, Hungary and Latvia. In these countries, the female advantage in education, if any, is more pronounced in the native population. The opposite happens in the Netherlands, Austria, Cyprus, and Italy, where the sex ratio for the highly educated is higher for natives than for immigrants. In the latter group of countries, the female advantage in education, if any, tends to be bigger among immigrants.

The usefulness of these kinds of statistics has some clear limitations. First, there is a lack of detail about the origin of the immigrants. Given the fact that people tend to mate with people of similar origin (e.g., Dutch immigrants in Belgium marrying with Dutch immigrants), this is a major drawback which makes it impossible to relate these sex ratios to any specific tendencies for endogamy. Second, these statistics do not tell us anything about the ethnic background of the men and women counted. For example, men and women whose parents were born in Morocco, but who were born in Belgium themselves, are counted in the group of natives along with men and women without any migration background in the recent family history, even though the tendency for ethnic endogamy is strong (with men and women of Moroccan background more likely to form a union).

*Figure 9. Sex ratios for people with a degree in tertiary education, natives versus immigrants, men aged 27-46/ women aged 25-44, European countries, 1998-2011 (log-scale).**




Source: Eurostat harmonzid LFS, data prepared by Joan Garcia-Román & Albert Esteve, own calculations

* See the discussion of Figure 1 for the way the numbers in the male intervals had to be estimated

## 5. Conclusion

Originally, the marriage squeeze refers to the effect of the imbalance between the number of men and women of marriageable ages on marriage rates. In this paper, we proposed an update of the marriage squeeze concept so that it incorporates not only age and sex but two other marriage-relevant characteristics: education and union status. With the education-specific

mating squeeze we introduce a framework to measure the effect of the reversal of gender imbalances in education on union and family formation and aim to build new bridges between two classic areas in the study of union formation: the marriage squeeze hypothesis and trends in educational assortative mating.

In the literature, there is no general agreement on how the marriage squeeze should be operationalized. Most studies compute sex ratios, sometimes in very refined ways, but Schoen (1983) and Esteve et al. (2012) offer alternative approaches that have not yet been compared to the sex ratio approach. We focus on sex ratios to reconstruct time series of the education-specific mating squeeze for European countries and take a closer look at the practical consequences that arise when measuring the mating squeeze.

We demonstrated that sex ratios are sensitive to the assumed age difference between men and women. We recommend to take a two- or three year age difference into account, because failing to do this will miss out potentially important temporal variation in the mating squeeze. On the other hand, computing sex ratios for five- or for ten-year age groups generate more or less the same results. We should be cautious with measures based on very small age intervals since they are more liable to erratic fluctuations caused by sampling errors. Broader age groups proof to be more robust. In addition, they do not only include a larger pool of potential available mates, but also the competition from members of the same sex for that pool. As such, with sex ratios calculated for broad age ranges, some of the conceptual advantages of more sophisticated Availability Ratios are obtained in an implicit but simpler way.

Measures based on very broad age ranges (say 30 years) or crude sex ratios may not be able to detect a marriage squeeze and disregard the fact that marriage market conditions, including age preferences, for younger adults differ from marriage market conditions for older adults. For older adults, and in particular for older men, the age sorting norms are less strict, so broader age ranges are recommended.

In addition, we showed that for older adults sex ratios computed for singles are more skewed and deviate from sex ratios computed for all marital statuses. For younger adults, this is not the case. For younger adults, sex ratios computed for singles are similar to sex ratios computed for all persons.

While it is intuitively appealing to exclude those who are living with a partner from marriage market measures, this is not always preferred. Sex ratios based on the single population can cause problems of endogeneity, since the number of single men and women is also an outcome of union formation and union dissolution. This is in general a problem with more complex sex ratio measures that constrain the marriage market too much. These

constrains are based on observed practices which not only reflect existing preferences but also the accommodation to the supply and demand of the marriage market at that time. As a result, they entail endogeneity issues. In some cases, if data allow doing this, these issues may be addressed by linking sex ratio measures at time t1 with rates of union formation at time t2.

As mentioned before, most studies of the mating and marriage squeeze so far have relied on measures based on the sex ratio. Still, Schoen (1983) and Esteve et al. (2012) offer alternative approaches that have hardly been tried and tested in studies of union formation and assortative mating. This is a job still to be done in future studies.

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